I N S T R U C T I O N S

MODEL 200A

AUDIO OSCILLATOR

SERIAL 30,000 AND ABOVE

INSTRUCTIONS

MODEL 200A

AUDIO OSCILLATOR

Specifications

Frequency Rating --

Frequency Range - 35 to 35,000 cycles/sec.

Frequency Dial Calibration - 35 to 350

Range -

x1	30 - 350 cycles/sec.
x10	350 - 3500 cycles/sec.
x100	3500 - 35,000 cycles/sec.

Calibration Accuracy - ± 2%

Frequency Response - ±1 db 20 - 15,000 cycles/sec.
Reference: 1000 cycles/sec., 22.4 volts, 500 ohms resistive load.

Frequency Stability - ± 2% under normal temperature conditions, including initial warm-up.
± 10% power line voltage variations change the frequency less than ± .2% at 1000 cycles/sec.

Power Output Rating --

Power Output - 1 watt into rated load (22.4 volts across a 500 ohm load; 25 volts open circuit.

Distortion - Less than 1% of rated output from 35 to 15,000 cycles/sec.

Hum - Less than .1% of maximum output voltage

Load Impedance - 500 ohms (resistive)

Approximate Internal Impedance - 75 ohms from 20 to 15,000 cycles/sec. Output ungrounded, not balanced to ground.

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Power Supply Rating --

Voltage - 115 volts
Frequency - 50 to 60 cycles/sec.
Wattage - 75 watts

Overall Dimensions --

Cabinet Model - 15-1/4" long x 7-1/4" high x 10-5/8" deep

Rack Model - 19" long x 7" high x 10-3/4" deep
Panel - 19" long x 7" high
Depth behind panel - 9-1/4"

Weight --

Cabinet Model - 26-1/2 pounds
Rack Model - 26-1/2 pounds

Operating Instructions

Inspection --

This instrument has been thoroughly tested and inspected before being shipped and is ready for use when received.

After the instrument is unpacked it should be carefully inspected for any damage received in transit. If any shipping damage is found, follow the procedure outlined in the "Claim for Damage in Shipment" page at the back of this instruction book.

Controls and Terminals --

AC Power - This toggle switch, which is located in the lower left corner of the control panel, controls the power supplied to the instrument from the power line. When the switch is in the on position, the red indicator will glow.

Fuse - The fuseholder, located on the underside of the chassis next to the power cable, contains a one ampere cartridge fuse.

RANGE - This rotary switch inserts various range resistors in the frequency determining circuit of the oscillator. The position of this switch indicates the multiplying factor for the frequency dial calibration.

Frequency Dial - The frequency dial is calibrated directly in cycles per second for the lowest frequency range.

AMPL.- This variable resistor controls the amplitude of the oscillator voltage admitted to the amplifier, and therefore the output voltage of the instrument. This control is calibrated from "0" to "100" in arbitrary units.

Power Cable - The power cable consists of three conductors. Two of these conductors carry power to the instrument while the third conductor (green wire) is connected to the instrument chassis. The third wire projects from the cable near the plug end of the cable and may be connected to a ground when it is desirable to have a grounded chassis.

Operation --

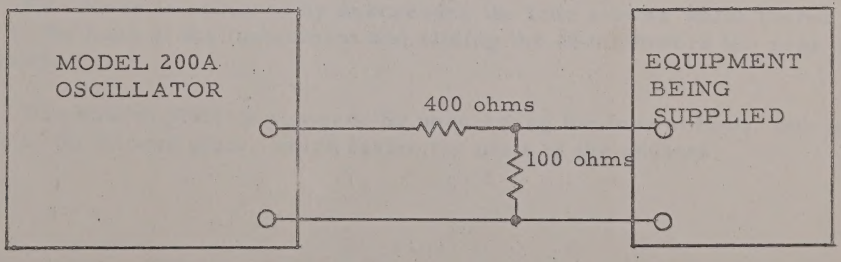
Plug the power cable of the Model 200A into a nominal 115 volts, 50/60 cycles power source and turn on the AC power switch. The instrument will begin to operate as soon as the tubes have heated, but for maximum accuracy a warm-up period of about 30 minutes is necessary.

Set the frequency dial and "RANGE" switch so that their indications, when multiplied together, equals the desired frequency. For example, if it is desired to select an output frequency of 800 cycles per second, set the frequency dial to "80" and the "RANGE" switch to "x10".

Connect the oscillator output binding posts to the equipment being driven and adjust the "AMPL." control for the desired output voltage.

Although the rated load for the Model 200A is 500 ohms (resistive), higher or lower impedance loads may be used without damage to the instrument. A higher impedance load will result in less power output and a lower impedance load will increase the percentage of distortion in the output voltage.

As the output voltage of the audio oscillator is reduced the percentage of hum voltage will increase. At the lower levels this hum voltage becomes quite large, relative to the sine wave output voltage. This undesirable condition can be remedied by operating the audio oscillator at or slightly below rated output and inserting a suitable attenuator between the oscillator and the equipment being driven by the oscillator. The voltage divider circuit shown below is satisfactory for most applications.



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Other values of resistance may be used to obtain different voltage divisions. In all cases, the sum of the divider resistors must equal the rated load of 500 ohms.

Circuit Description

The Model 200A Audio Oscillator consists of an oscillator section, an amplifier section and a power supply.

The oscillator section (tubes V1 and V2) is a resistance-tuned type circuit. Basically, this oscillator is a two-stage resistance-coupled amplifier which is caused to oscillate by the use of a positive feedback network. This network is a frequency-selective resistance-capacity combination which controls the frequency of oscillation. By using a variable tuning capacitor for the capacity of the network, it is possible to tune the oscillator over a wide 10:1 range, and by using a switching arrangement to select different values of resistance for the network, several ranges are given to the oscillator.

Negative feedback is used in the oscillator section in order to minimize distortion and to obtain a very high order of stability. The amount of negative feedback is determined by a resistance network, one element of which is nonlinear (the 3-watt lamp in the cathode of V1). This element controls the amount of feedback in accordance with the amplitude of oscillation and consequently maintains the amplitude of oscillation substantially constant over a wide frequency range. The negative feedback also keeps the operation of the system on the linear portion of the tube characteristic. It is notable that the lamp has sufficient thermal inertia so that it operates well even at low frequencies.

Following the oscillator is the output amplifier section which includes tubes V3 and V4. Negative feedback is used in this amplifier in order to minimize distortion and to provide a good frequency response.

The power supply section includes a conventional full-wave rectifier with a low-pass pi filter for removing the ac components from the rectified wave.

Maintenance

Cover and Bottom Plate Removal --

The cover is removed by unscrewing the four screws which fasten the cover to the back of the instrument and sliding the cover toward the rear of the instrument.

The bottom plate is removed by unscrewing the four screws, one in each corner of the bottom plate, which fasten the plate to the chassis.

Tube Replacement --

When replacing any of the tubes except the power rectifier, it is desirable to measure the distortion in the output if maximum performance from the instrument is desired, because a poor tube can cause excessive distortion without seemingly affecting the operation. The distortion should be less than 1% of the rated output with rated load.

Replacement of Lamp R7 --

The 3-watt lamp R7 is operated at a very low level and should have an almost infinite life. Therefore, the lamp should not be changed indiscriminately. However, should the lamp require changing, it is necessary to check the ac voltage from the junction of R19 and C4 to ground with the new lamp in the circuit. As measured with a high-impedance ac vacuum tube voltmeter, this voltage should be within the range of approximately 20 - 22 volts when the Model 200A is tuned to 400 cps. If the voltage is not within this range, it may be corrected by adjusting R11.

If the voltage cannot be brought within the range from 20 - 22 watts by means of R11, the new lamp should be rejected in favor of another.

Intermittent Output --

"Jumpy" or intermittent output accompanied by flashing of the 3-watt oscillator lamp (R7) is a reliable indication of a short in trimmer capacitor C1 or in the first two sections of the main tuning capacitor. If these symptoms occur, search out and clear the short with a weak air jet or other means. Do not bend the capacitor plates because bending capacitor plates will destroy the frequency calibration.

A short in the back two sections of the main tuning capacitor or in trimmer C6 will prevent the circuit from oscillating. Any such short should be cleared as explained above.

Distortion --

Distortion may be caused by defective tubes, electrical leakage in the coupling capacitors, defective output transformer, defective electrolytic capacitors, low DC supply voltage, or excessive output voltage from the oscillator section.

Dial Coupler --

An insulated coupler connects the main tuning dial to the shaft of the main tuning capacitor. If this coupler should become loosened, rotate the capacitor completely clockwise. To do this it will be necessary to loosen the collar

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of the stop on the rear of the panel bearing. When the capacitor is completely closed, set the main tuning dial so that the dot to the left of "35" on the main tuning dial is exactly under the hairline. Tighten the coupler with the tuning dial and tuning capacitor in these relative positions. Then tighten the collar of the stop so that the tuning capacitor rotor cannot strike the frame or stator at either end of its arc.

After the coupler has been tightened and the dust cover replaced, it is desirable to check the calibration of the instrument.

Frequency Calibration --

If a change occurs in the frequency calibration of this instrument after a long period of use, the cause of this change probably lies in the ageing of the resistors in the frequency-determining network. These resistors have extremely good stability, however, and the frequency calibration will remain accurate for a very long period of time.

Each of the frequency-determining resistors consists of a precision one-watt resistor in series with a one-half watt resistor. The latter is selected to give the instrument a very accurate frequency calibration. Therefore, adjusting the frequency calibration requires that the value of these small resistors be changed as necessary to obtain proper calibration.

An oscilloscope, an ac vacuum tube voltmeter, and a secondary frequency standard are needed to adjust the calibration of the Model 200A. The secondary standard should have sinusiodal output and should provide frequencies of at least 1 kc and 10 kc. Before recalibrating, allow the Model 200A to heat for thirty minutes or more. Then connect the Model 200A to the vertical deflecting-plate input of the oscilloscope and the secondary frequency standard to the horizontal deflecting-plate input.

Next, check the calibration of the Model 200A by means of Lissajous figures on the oscilloscope, determining whether the frequencies generated by the Model 200A are in general higher or lower than the dial calibration. When making this check, it is necessary that the dust cover be tightly on the instrument as the frequency calibration will change when the dust cover is loose or off the instrument.

If the instrument is in need of recalibration, the dial calibration will show a definite trend of error - either higher or lower than the true output frequency for each range. The various ranges of the instrument do not necessarily change in the same "direction".

If the x1 range requires readjusting, change the small resistors R1A and R4A. If the output frequency is higher than the dial calibration, increase the value of the small resistors; if the output frequency is lower than the dial calibration, decrease the value of the small resistor. A change of about 50,000

ohms will change the calibration about 1/2%. Do not change the value of R1 and R1A more than 50,000 ohms without making a corresponding change in R4 and R4A, because it is necessary to keep the values of each set of range resistors as equal as possible. Unbalance in the resistors will tend to cause the oscillator to be unstable. After each change it is necessary to replace the dust cover securely before checking the output frequency.

The same procedure should be used if it is necessary to adjust the calibration of the other ranges. On the x10 range a change greater than 5,000 ohms should not be made in R2 and R2A without also changing R5 and R5A. On the x100 range a change greater than 500 ohms should not be made in R3 and R3A without changing R6 and R6A.

It is important that the dust cover be tightly in place after each adjustment, because the frequency calibration is affected by the position of the dust cover.

If any considerable amount of change in the resistors is necessary, it may be desirable to replace the entire range switch assembly. These assemblies are available from the Hewlett-Packard Company.

The vacuum tube voltmeter should be used to check the output from the instrument after the recalibration has been completed. Set the main frequency dial of the Model 200A to "100" and the AMPL. control to about "80" or more. Connect the VTVM to the output terminals and measure the output of each range. If the range switch resistors have been properly adjusted, the difference between the output of the ranges with the dial set at "100" should be within 1 db (approximately 12%), preferably less. If the difference in output is greater than 1 db, the usual cause is that the frequency determining resistors for the range in question are not properly balanced.

Trimmer Capacitors --

Two trimmer capacitors are provided for the main tuning capacitor. These trimmers are adjusted at the factory and do not require further adjustment for the life of the equipment. If the trimmers inadvertently should become misadjusted, directions for resetting should be requested of the Hewlett-Packard Company.

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Trouble Shooting --

The following is a listing of possible symptoms, causes, and remedies.

Symptoms	Causes	Remedies
Instrument inoperative (Indicator lamp won't light, no audio output)	Blown fuse	Clear short circuit and replace fuse.
Instrument inoperative (Indicator lamp lights, no audio output)	Defective tube Check the 5Y3GT tube first	Replace tube (see "Tube Replacement" in Maintenance section)
	Short circuit in DC power circuit capacitor	Replace capacitor
	Short circuit in C2 (two rear sections) or C6	Clear the short circuit as outlined in the "Intermittent Output" paragraph in the Maintenance section.
Intermittent Output	Capacitors C4 or C5 intermittently open.	Replace capacitor.
	Short circuit in C2 (two front sections) or C1	Clear the short circuit as outlined in the "Intermittent Output" paragraph in the Maintenance section.

Circuit Ref.	Description	-hp- Stock No.	Mfr. & Mfrs. Designation
C1	Capacitor: variable, air, 100 mmf	12-11	Sarkes-Tarzian A-103L
C2	Capacitor: variable, air, 530 mmf per sect.	12-5	Hewlett-Packard(HP)
C3	Capacitor: fixed, paper, .5 mf; 600 vdcw	16-5	Aerovox Type 684
C4	Capacitor: fixed, paper, 4, 4 mf; 600 vdcw	17-44	Girard-Hopkins P8-8
C5	Capacitor: fixed, paper, .1 mf, 600 vdcw	16-1	Aerovox Type P688
C6	Capacitor: variable, air, 100 mmf	12-11	Sarkes-Tarzian A-103L
C7	Capacitor: Factory Adjustment		
C8	Capacitor: fixed, paper, 2000 mmf; -25% +50% 600 vdcw	16-22	Aerovox Type 684
C9 ab	Capacitor: fixed, electrolytic, 10,10,10, mf; 450 vdcw	18-31	PR Mallory FPT-389
C10	Capacitor: fixed, paper, 4 mf; 800 vdcw	17-3	Girard-Hopkins P8-4
C11	Capacitor: fixed, electrolytic, 40 mf; 450 vdcw	18-40	PR Mallory FPS-146
C12	Capacitor: fixed, mica, 27 mmf; ± 10% 500 vdcw	14-17	Micamold Radio Corp. Type OXM
C13	Capacitor: Factory Adjustment		
C14	Capacitor: fixed, electrolytic, 50 mf; 50 vdcw	18-50	PR Mallory TC-39
R1-R6	Part of Range Switch Assembly		
R7	Lamp: 3-watts; 120V	211-4	GE Supply

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Circuit Ref.	Description	-hp- Stock No.	Mfr. & Mfrs. Designation
R8	Resistor: fixed, composition, 47,000 ohms; ± 10% 1W	24-47K	Allen-Bradley (AB) GB 4731
R9	Resistor: fixed, composition, 100,000 ohms; ± 10% 2W	25-100K	AB HB 1041
R10	Resistor: fixed, composition, 100,000 ohms; ± 10% 1W	24-100K	AB GB 1041
R11	Resistor: variable, wirewound, 1000 ohms; linear taper	210-5	Centralab 21-010-355
R12	Resistor: fixed, wirewound, 3000 ohms; ± 10% 1W	26-3000	Internat. Resistance Co. Type BW
R13	Resistor: fixed, composition, 560,000 ohms; ± 10% 1W	24-560K	AB GB 5641
R14	Resistor: fixed, composition, 820 ohms; ± 10% 2W	25-820	AB HB 8211
R15	Resistor: fixed, wirewound, 25,000 ohms; ± 10% 10W	26-11	Lectrohm Type 1-3/4E
R16	Resistor: fixed, wirewound, 10,000 ohms; ± 10% 10W	26-10	Lectrohm Type 1-3/4E
R17	Resistor: fixed, wirewound, 10,000 ohms; ± 10% 20W	27-4	Lectrohm Type 2R
R18	Resistor: variable, composition, 25,000 ohms; linear taper	210-54	AB JU 2531
R19	Resistor: fixed, composition, 15K ohms; ± 10% 1W	24-15K	AB GB 1531
R20	Resistor: fixed, composition, 3300 ohms; ± 10% 1W	24-3300	AB GB 3321
R21	Resistor: fixed, composition, 56,000 ohms; ± 10% 1W	24-56K	AB GB 5631
R22	Resistor: fixed, composition, 560,000 ohms; ± 10% 1W	24-560K	AB GB 5641

Circuit Ref.	Description	-hp- Stock No.	Mfr. & Mfrs. Designation
R23	Resistor: fixed, composition, 56,000 ohms; ± 10% 1W	24-56K	AB GB 5631
R24	Resistor: fixed, composition, 820 ohms; ± 10% 2W	25-820	AB HB 8211
R25	Resistor: fixed, composition, 10,000 ohms; ± 10% 1W	24-10K	AB GB 1031
R26	Resistor: fixed, composition, 10,000 ohms; ± 10% 1W	24-10K	AB GB 1031
R27	This circuit reference not assigned		
R28	Resistor: fixed, composition, 33 ohms; ± 10% 1W	24-33	AB GB 3301
	Binding Post:	312-3	HP
F1	Fuse: 1A; 3AG	211-1	Littelfuse 312001
	Fuseholder:	312-7	Littelfuse 351011
	Power Cable:	812-56	HP
	Knob: 3" diam	37-14	HP
	Knob: 1-1/2" diam	37-11	HP
I1	Lamp:	211-47	GE Supply #47
	Indicator Light:	312-10	Signal Indicator Co. 807BS
L1	Reactor: 6 H @ 125 MA; 240 ohms	911-4	HP
	Coupling Assembly:	M-25B	HP
	Panel Bearing Assembly:	M-67	HP
S1, R1-R6	Range Switch Assembly:	A-19W	HP

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Circuit Ref.	Description	-hp- Stock No.	Mfr. & Mfrs. Designation
S2	Switch: Toggle	310-11	Arrow-Hart & Hegeman 20994-HW
T1	Transformer: Output	912-3	HP
T2	Transformer: Power	910-3	HP
V1	Tube: 6J7	212-6J7	Any tube with RMA standard characteristics
V2	Tube: 6F6	212-6F6	"
V3	Tube: 6F5	212-6F5	"
V4	Tube: 6V6	212-6V6	"
V5	Tube: 5Y3GT	212-5Y3GT	"

INSTRUCTIONS FOR RECTIFIER TUBE REPLACEMENT

These instructions apply to any Hewlett-Packard instrument in which a 5V4 tube is mounted in the power rectifier tube socket. When it is necessary to replace the rectifier tube, a 5Y3GT tube may be used as a replacement if the following instructions are followed.

INSTRUMENTS WITH DC VOLTAGE REGULATOR CIRCUIT -

The 5V4 tube may be replaced by a 5Y3GT tube without any circuit changes. After the 5Y3GT tube has been installed, the regulated voltage should be measured to see if it agrees with the voltage shown on the schematic wiring diagram in the instruction book. If the regulated voltage is incorrect it may be corrected by following the instructions in the instruction book.

INSTRUMENTS WITHOUT DC VOLTAGE REGULATOR CIRCUIT -

The 5V4 tube may be replaced by a 5Y3GT tube providing the resistor, in series with the DC output of the rectifier, is removed. This resistor does not appear in the schematic wiring diagram in the instruction book. The following instruments use a 500 ohms series resistor: Models 200A, 200B, 200C, 200D, 202D, 210A, 330BCD, and the 400A.

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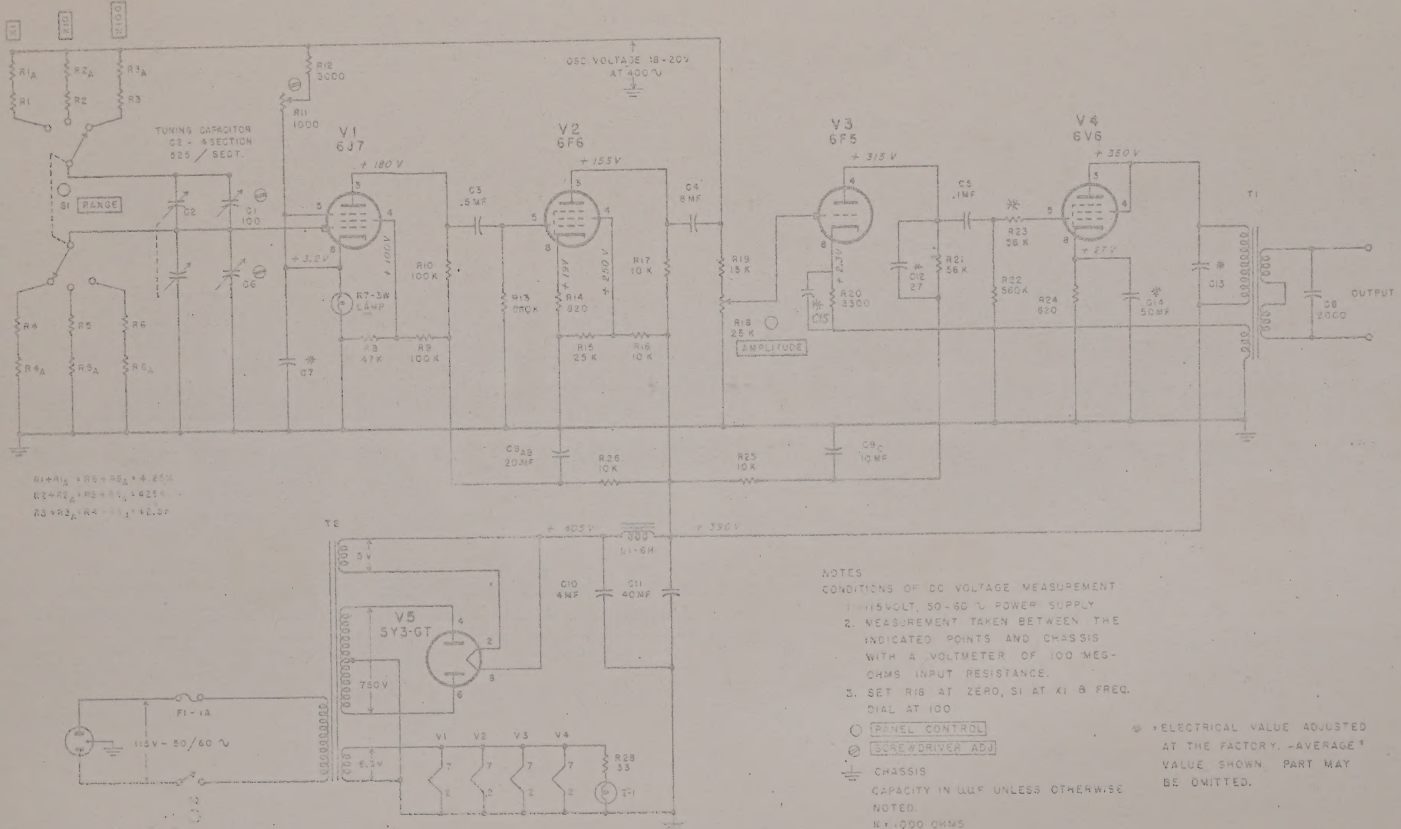


NOTES

CONDITIONS OF DC VOLTAGE MEASUREMENT

1. 115 VOLT, 50-60 ~ POWER SUPPLY
2. MEASUREMENT TAKEN BETWEEN THE INDICATED POINTS AND CHASSIS WITH A VOLTMETER OF 100 MEGOHMS INPUT RESISTANCE.
3. SET R18 AT ZERO, S1 AT X1 & FREQ. DIAL AT 100

○ PANEL CONTROL

⊘ SCREWDRIVER ADJ.

⏚ CHASSIS

CAPACITY IN MMF UNLESS OTHERWISE NOTED.

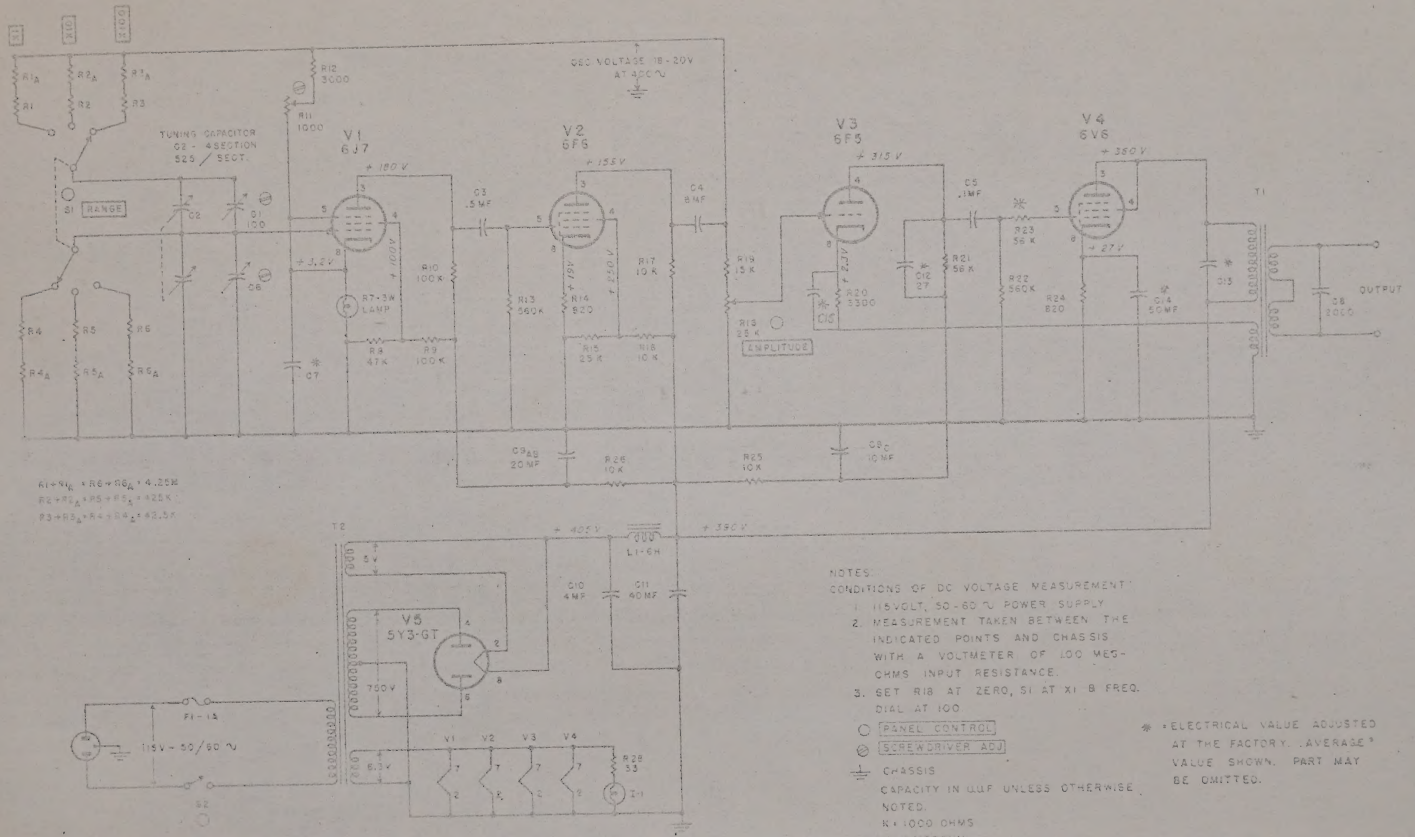
K = 1000 OHMS

M = 1 MEGOHM

* = ELECTRICAL VALUE ADJUSTED AT THE FACTORY. "AVERAGE" VALUE SHOWN. PART MAY BE OMITTED.

SCHEMATIC DIAGRAM OF MODEL 300A AUDIO OSCILLATOR

SERIAL NO. 30000 TO



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○ PANEL CONTROL
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CAPACITY IN UUF UNLESS OTHERWISE NOTED.
K = 1000 OHMS
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SCHEMATIC DIAGRAM OF MODEL 200A AUDIO OSCILLATOR
SERIAL NO. 20,000 TO